



# STP16C596

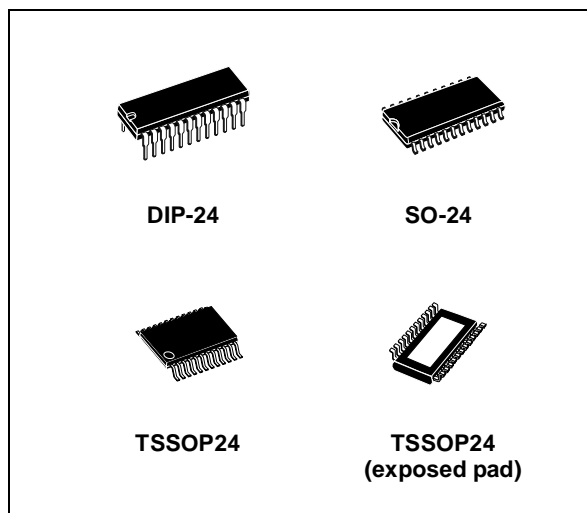
## 16-BIT CONSTANT CURRENT LED SINK DRIVER

- 16 CONSTANT CURRENT OUTPUT CHANNELS
- ADJUSTABLE OUTPUT CURRENT THROUGH EXTERNAL RESISTOR
- SERIAL DATA IN/PARALLEL DATA OUT
- SERIAL OUT CHANGE STATE ON THE FALLING EDGES OF CLOCK
- OUTPUT CURRENT: 15-120 mA
- 25 MHz CLOCK FREQ.
- AVAILABLE IN HIGH THERMAL TSSOP EXPOSED PAD
- EFFICIENCY PACKAGE

### DESCRIPTION

The STP16C596 is a monolithic, medium-voltage, low current power 16-bit shift register designed for LED panel displays. The STP16C596 contains a 16-bit serial-in, parallel-out shift register that feeds a 16-bit D-type storage register. In the output stage, sixteen regulated current sources are designed to provide 15-120mA constant current to drive the LEDs.

The serial output change state on the falling edges of clock, this special feature will provide an improved performance of the application when the clock signal is skewed because the daisy chain is too long.



Through an external resistor, users may adjust the STP16C596 output current, controlling in this way the light intensity of LEDs.

The STP16C596 guarantees a 16V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 25 MHz, also satisfies the system demand for high volume data transmission. Compared with a standard TSSOP package, the TSSOP exposed pad increases heat dissipation capability by a 2.5 factor.

**Table 1: Order Codes**

Part Number	Package	Comments
STP16C596B1R	DIP-24	15 parts per tube
STP16C596M	SO-24 (Tube)	40 parts per tube
STP16C596MTR	SO-24 (Tape & Reel)	1000 parts per reel
STP16C596TTR	TSSOP24 (Tape & Reel)	2500 parts per reel
STP16C596XTTR	TSSOP24 Exposed-Pad (Tape & Reel)	2500 parts per reel

Table 2: Current Accuracy

Output Voltage	Current accuracy		Output Current
	Between bits	Between ICs	
$\geq 0.7V$	TYP. $\pm 3\%$	$\pm 10\%$	15 to 120 mA

Figure 1: Pin Connection

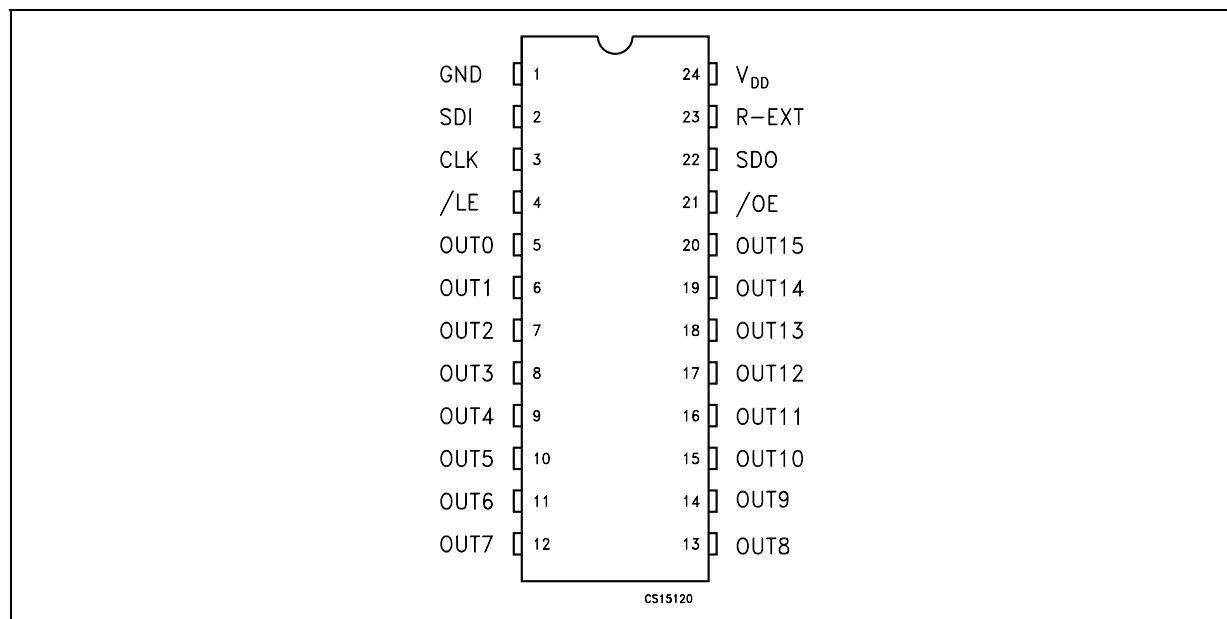


Table 3: Pin Description

PIN N°	Symbol	Name and Function
1	GND	Ground Terminal
2	SDI	Serial data input terminal
3	CLK	Clock input terminal
4	/LE	Latch input terminal
5-20	OUT 0-15	Output terminal
21	/OE	Input terminal of output enable (active low)
22	SDO	Serial data out terminal
23	R-EXT	Input terminal of an external resistor for constant current programing
24	V <sub>DD</sub>	Supply voltage terminal

**Table 4: Absolute Maximum Ratings**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	0 to 7	V
$V_O$	Output Voltage	-0.5 to 16	V
$I_O$	Output Current	120	mA
$V_I$	Input Voltage	-0.4 to $V_{DD}+0.4$	V
$I_{GND}$	GND Terminal Current	1920	mA
$f_{CLK}$	Clock Frequency	25	MHz
$T_{OPR}$	Operating Temperature Range	-40 to +125	°C
$T_{STG}$	Storage Temperature Range	-65 to +150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Under these conditions, functional operation is not implied.

**Table 5: Thermal Data**

Symbol	Parameter	DIP-24	SO-24	TSSOP24	TSSOP24 (exposed pad)	Unit
$R_{thj-amb}$	Thermal Resistance Junction-ambient	60	75	85	37.5	°C/W

**Table 6: Recommended Operating Conditions**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{DD}$	Supply Voltage		4.5	5.0	5.5	V
$V_O$	Output Voltage				16.0	V
$I_O$	Output Current	OUTn	5		120	mA
$I_{OH}$	Output Current	SERIAL-OUT			+1	mA
$I_{OL}$	Output Current	SERIAL-OUT			-1	mA
$V_{IH}$	Input Voltage		$0.7V_{DD}$		$V_{DD}+0.3$	V
$V_{IL}$	Input Voltage		-0.3		$0.3V_{DD}$	V
$t_{wLAT}$	/LE Pulse Width	$V_{DD} = 4.5$ to $5.5V$	20			ns
$t_{wCLK}$	CLK Pulse Width		20			ns
$t_{wEN}$	/OE Pulse Width		400			ns
$t_{SETUP(D)}$	Setup Time for DATA		20			ns
$t_{HOLD(D)}$	Hold Time for DATA		15			ns
$t_{SETUP(L)}$	Setup Time for LATCH		15			ns
$f_{CLK}$	Clock Frequency	Cascade Operation			25	MHz

**Table 7: Electrical Characteristics** ( $V_{DD}=5V$ ,  $T = 25^{\circ}C$ , unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{IH}$	Input Voltage High Level		$0.7V_{DD}$		$V_{DD}$	V
$V_{IL}$	Input Voltage Low Level		GND		$0.3V_{DD}$	V
$I_{OH}$	Output Leakage Current	$V_{OH} = 16\text{ V}$			10	$\mu A$
$V_{OL}$	Output Voltage (Serial-OUT)	$I_{OL} = 1\text{ mA}$			0.4	V
$V_{OH}$	Output Voltage (Serial-OUT)	$I_{OH} = -1\text{ mA}$	$V_{DD}-0.4V$			V
$I_{OL1}$	Output Current	$V_O = 0.7V$ $R_{EXT} = 910\ \Omega$	18.6	20.4	22.4	mA
$I_{OL2}$		$V_O = 0.7V$ $R_{EXT} = 360\ \Omega$	45.7	50.2	55.2	mA
$\Delta I_{OL1}$	Output Current Error between bit (All Output ON)	$V_O = 0.7V$ $R_{EXT} = 910\ \Omega$		$\pm 3$	$\pm 4$	%
$\Delta I_{OL2}$		$V_O = 0.7V$ $R_{EXT} = 360\ \Omega$		$\pm 3$	$\pm 4$	%
$R_{SIN(up)}$	Pull-up Resistor		150	300	600	$K\Omega$
$R_{SIN(down)}$	Pull-down Resistor		100	200	400	$K\Omega$
$I_{DD(OFF1)}$	Supply Current (OFF)	$R_{EXT} = \text{OPEN}$ OUT 0 to 15 = OFF		0.3	0.6	mA
$I_{DD(OFF2)}$		$R_{EXT} = 470\ \Omega$ OUT 0 to 15 = OFF		5.5	7.7	
$I_{DD(OFF3)}$		$R_{EXT} = 250\ \Omega$ OUT 0 to 15 = OFF		10.1	14.1	
$I_{DD(ON1)}$	Supply Current (ON)	$R_{EXT} = 470\ \Omega$ OUT 0 to 15 = ON		5.5	7.7	
$I_{DD(ON2)}$		$R_{EXT} = 250\ \Omega$ OUT 0 to 15 = ON		10.1	14.1	

**Table 8: Switching Characteristics** ( $V_{DD}=5V$ ,  $T = 25^{\circ}C$ , unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{PLH1}$	Propagation Delay Time, CLK-OUTn, /LE = H, /OE = L	$V_{DD} = 5\text{ V}$ $V_{IH} = V_{DD}$ $V_{IL} = \text{GND}$ $C_L = 13\text{ pF}$ $I_O = 40\text{ mA}$ $V_L = 3\text{ V}$ $R_{EXT} = 470\ \Omega$ $R_L = 65\ \Omega$		200	280	ns
$t_{PLH2}$	Propagation Delay Time, /LE-OUTn, /OE = L			160	250	ns
$t_{PLH3}$	Propagation Delay Time, /OE-OUTn, /LE = H			145	200	ns
$t_{PLH}$	Propagation Delay Time, CLK-SDO			15	30	ns
$t_{PHL1}$	Propagation Delay Time, CLK-OUTn, /LE = H, /OE = L			15	30	ns
$t_{PHL2}$	Propagation Delay Time, /LE-OUTn, /OE = L			15	30	ns
$t_{PHL3}$	Propagation Delay Time, /OE-OUTn, /LE = H			45	60	ns
$t_{PHL}$	Propagation Delay Time, CLK-SDO			15	300	ns
$t_r$	Output Rise Time			160	200	ns
$t_f$	Output Fall Time			15	25	ns

## EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

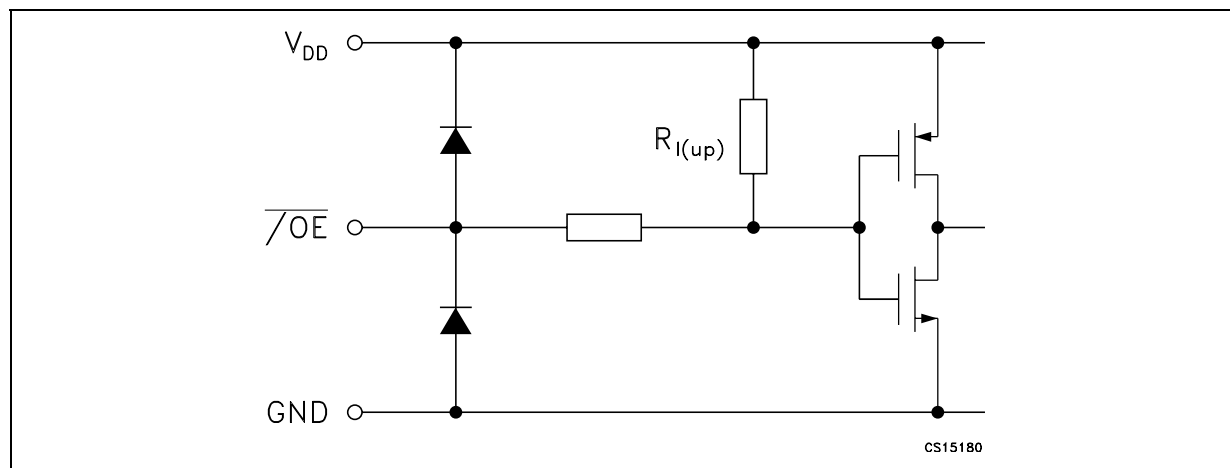
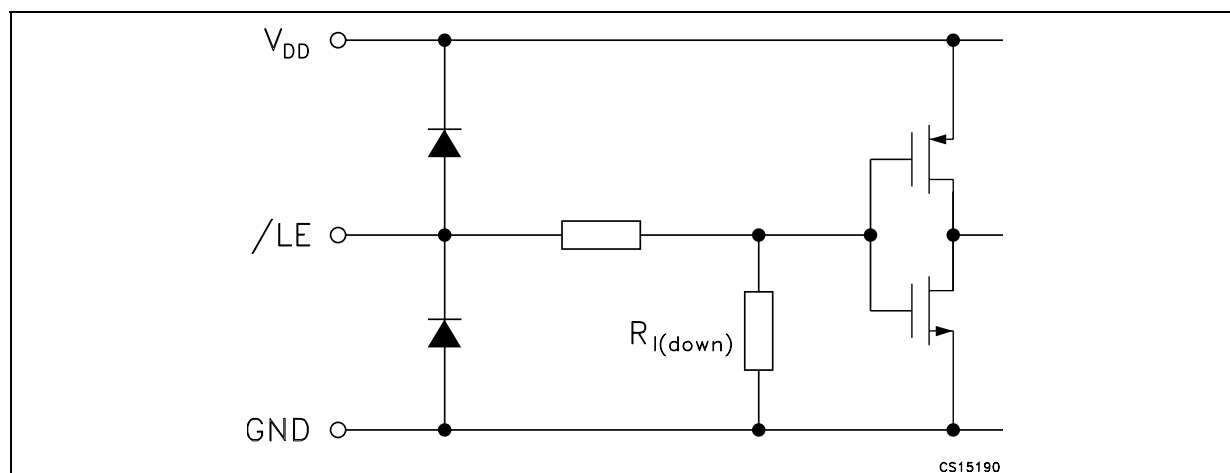
Figure 2:  $\overline{\text{OE}}$  TerminalFigure 3:  $\overline{\text{LE}}$  Terminal

Figure 4: CLK, SDI Terminal

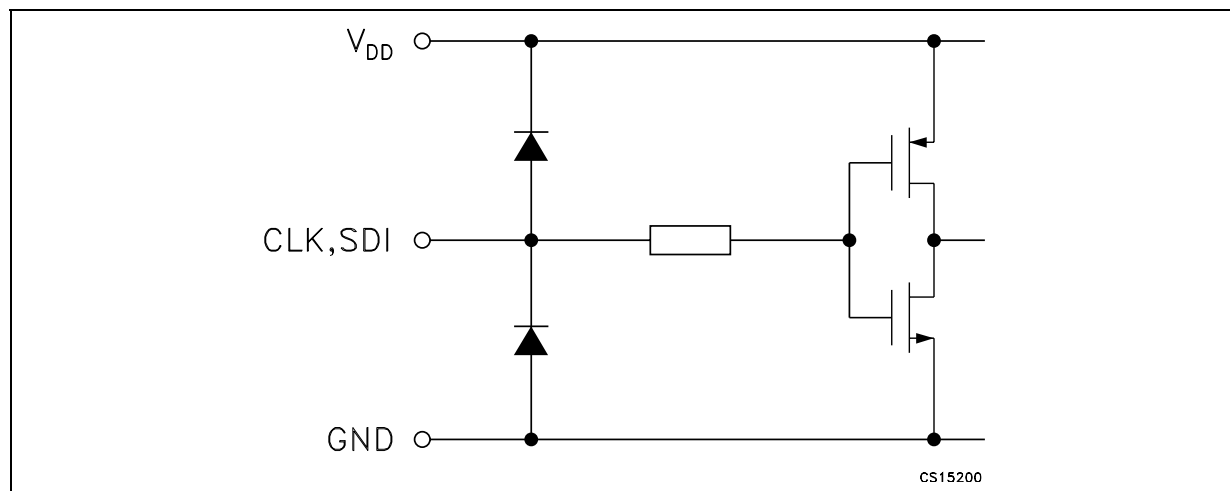


Figure 5: SDO Terminal

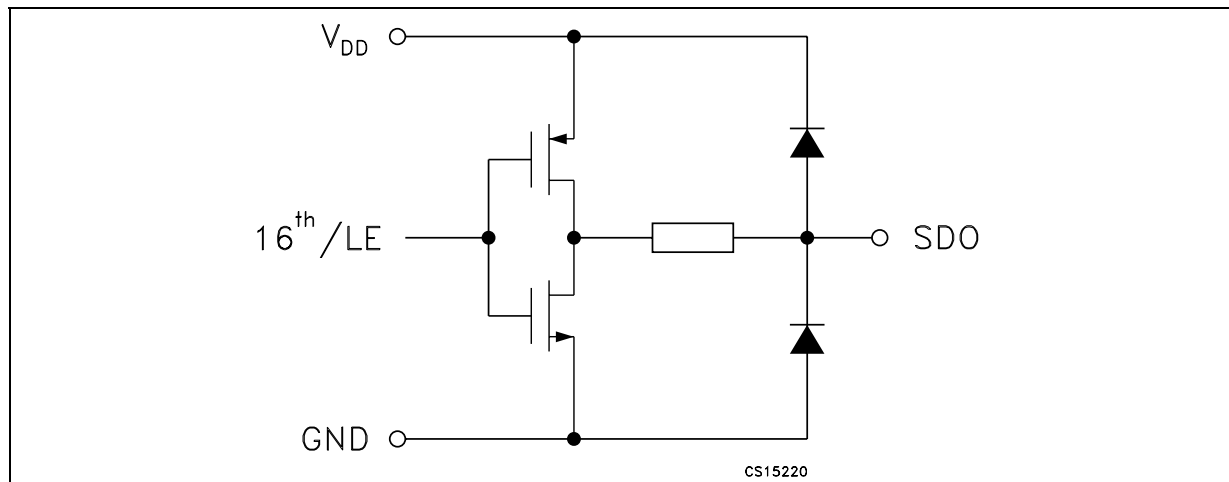


Figure 6: Block Diagram

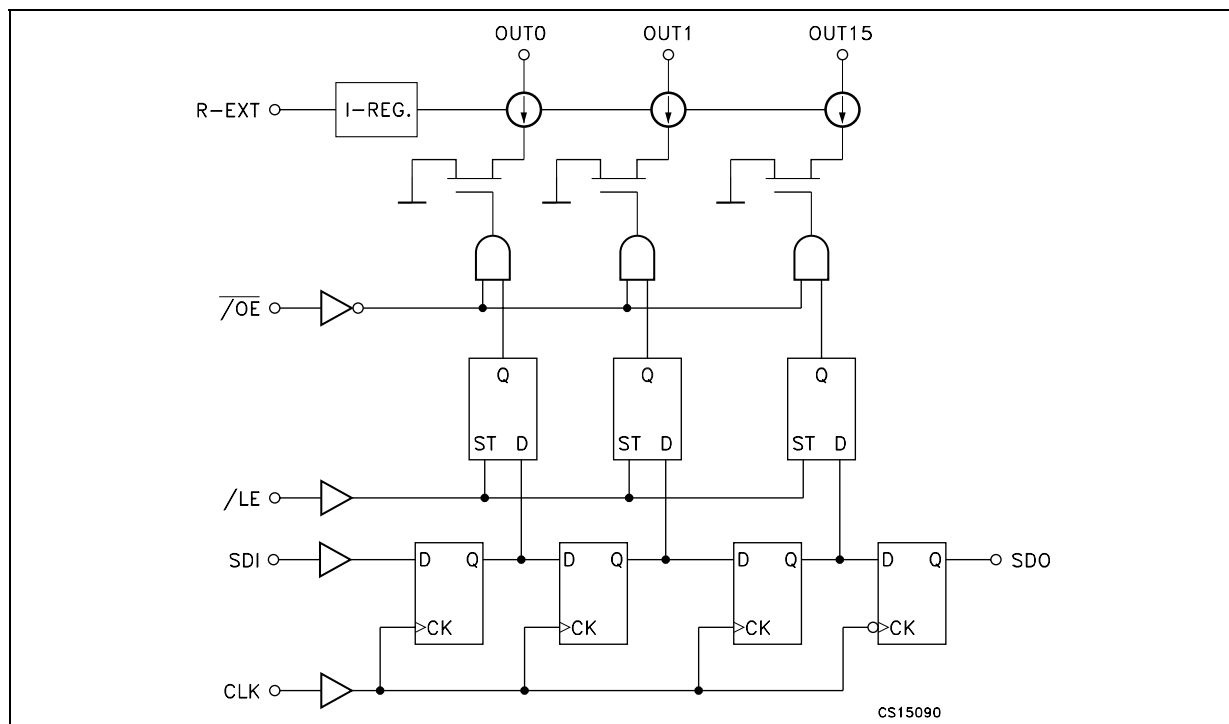
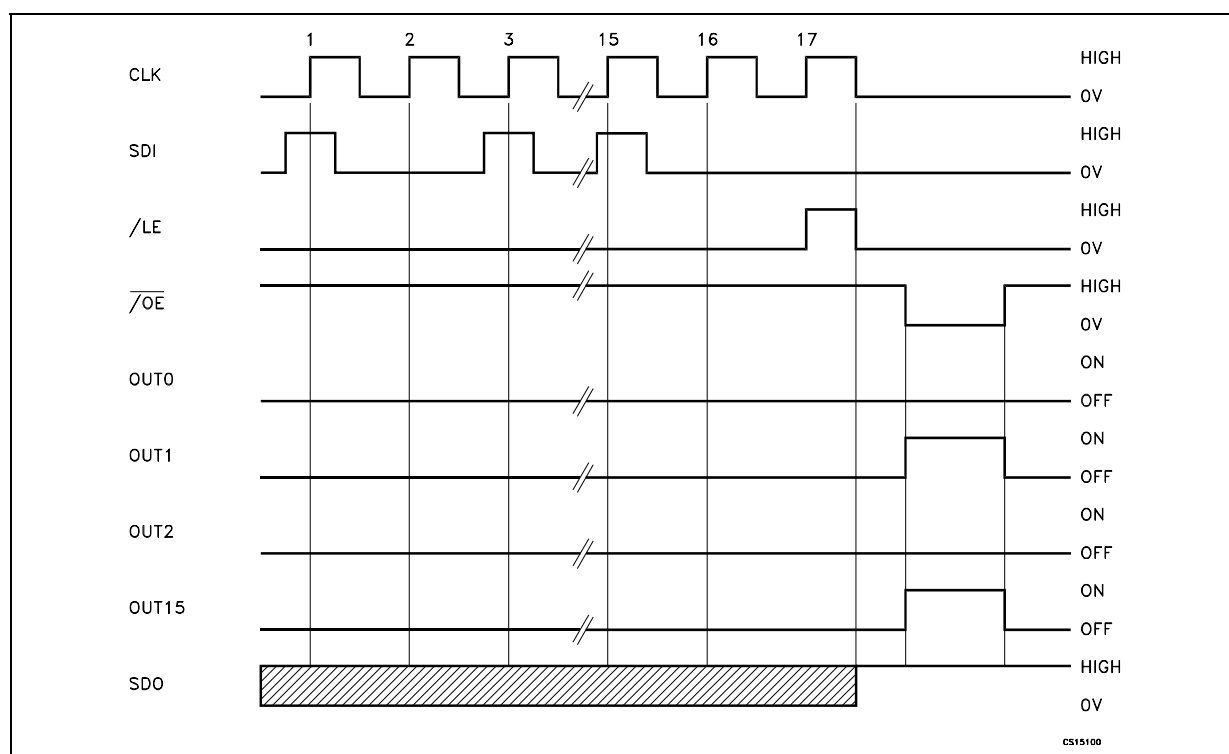


Table 9: Truth Table

CLOCK	/LE	/OE	SERIAL-IN	OUT0 ..... OUT7 ..... OUT15	SDO
	H	L	Dn	Dn ..... Dn - 7 ..... Dn -15	Dn - 15
	L	L	Dn + 1	No Change	Dn - 14
	H	L	Dn + 2	Dn - 2 ..... Dn - 5 ..... Dn -13	Dn - 13
	X	L	Dn + 3	Dn - 2 ..... Dn - 5 ..... Dn -13	Dn - 13
	X	L	Dn + 3	OFF	Dn - 13

Note 1: OUT0 to OUT15 = ON when Dn = H; OUT0 to OUT15 = OFF when Dn = L.

Figure 7: Timing Diagram



Note: The latches circuit holds data when the LE terminal is Low.

When LE terminal is at High level, latch circuit doesn't hold the data it passes from the input to the output.

When OE terminal is at Low level, output terminals OUT0 to OUT15 respond to the data, either ON or OFF.

When OE terminal is at High level, it switches off all the data on the output terminal.

Figure 8: Clock, Serial-in, Serial-out

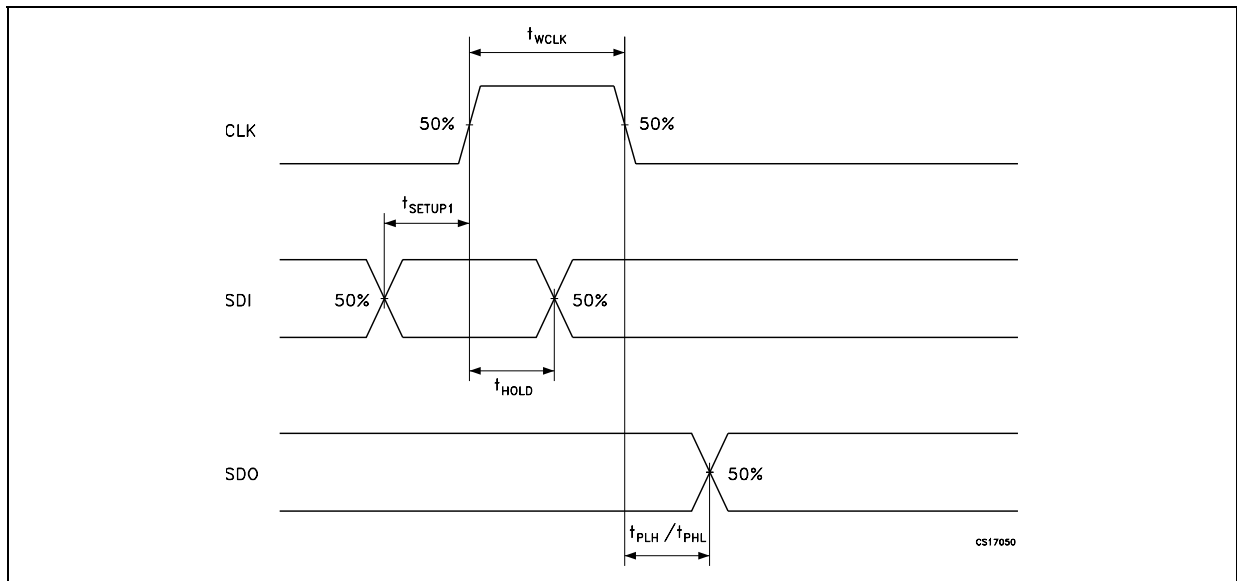


Figure 9: Clock, Serial-in, Latch, Enable, Outputs

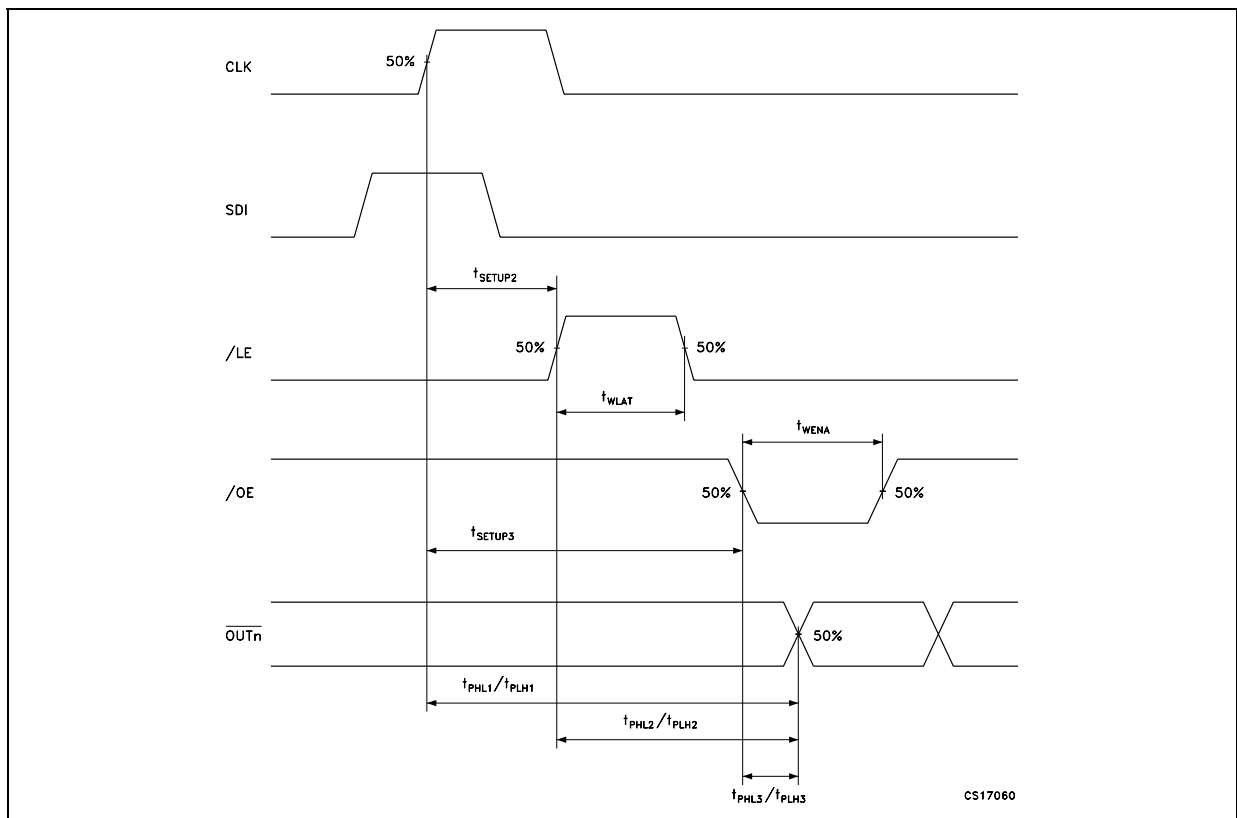
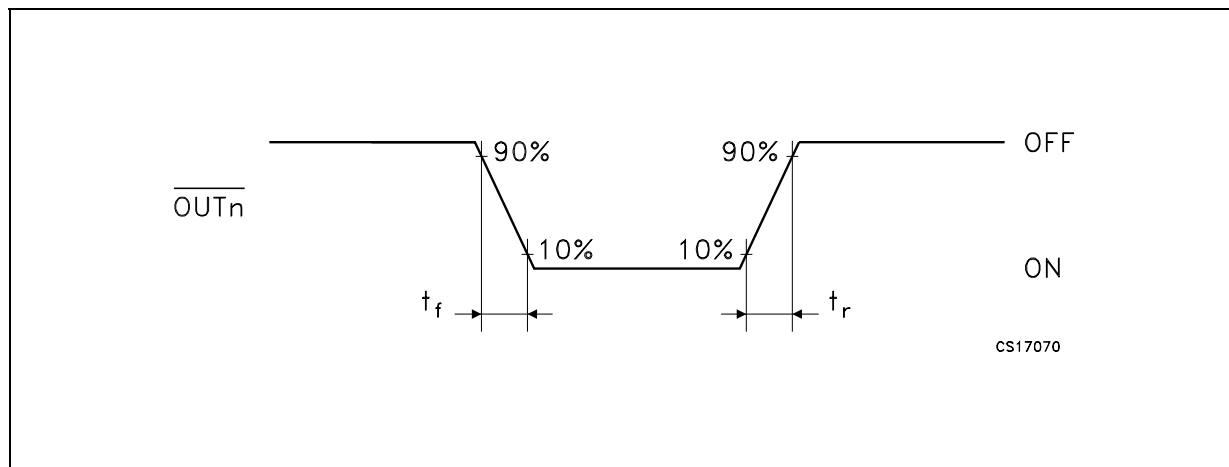




Figure 10: Outputs



## TEST CIRCUIT

Figure 11: DC Characteristic

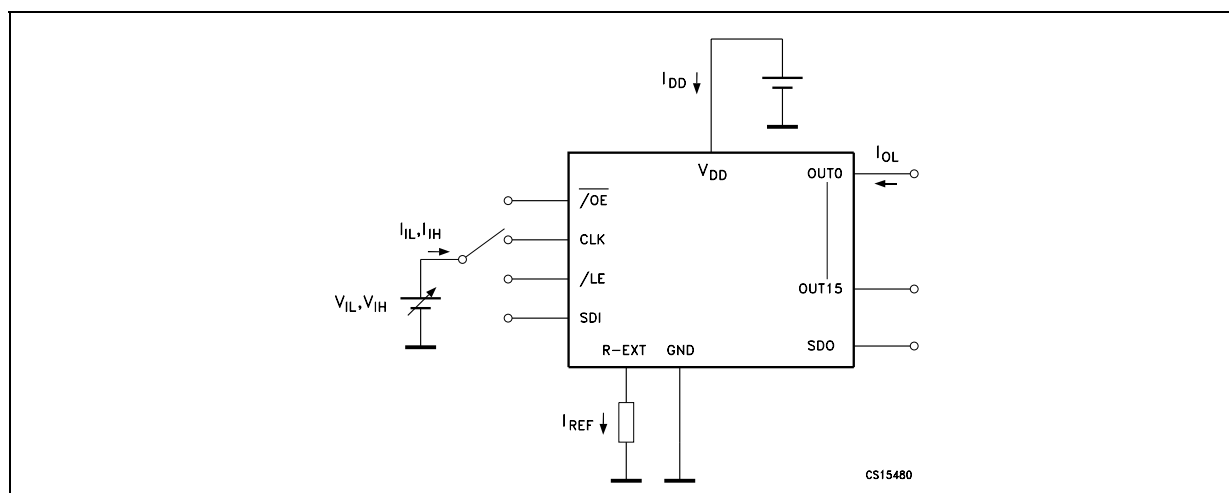
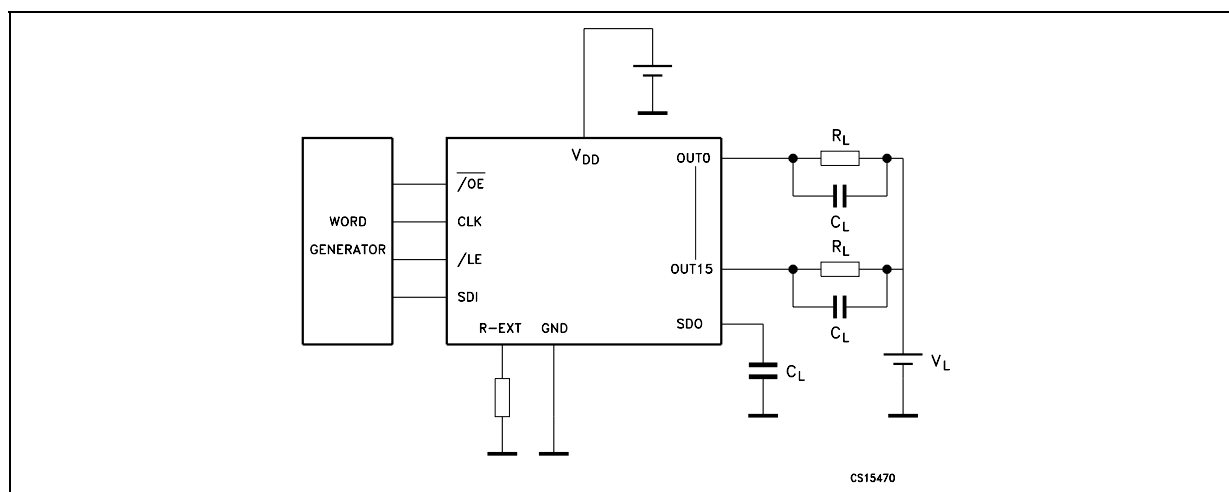
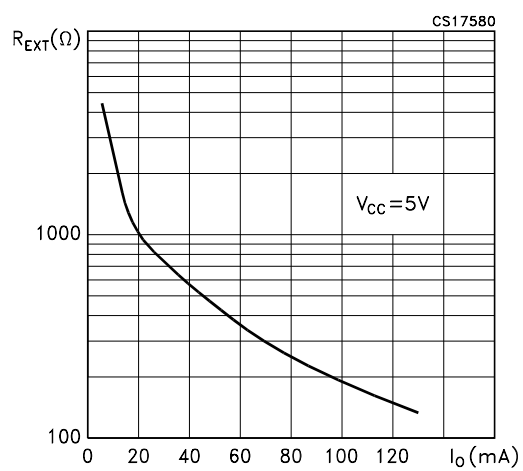
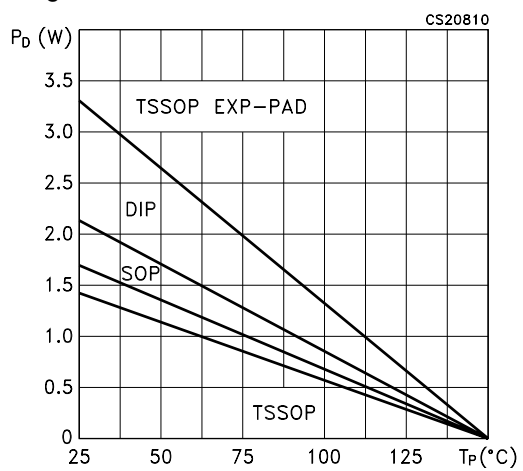


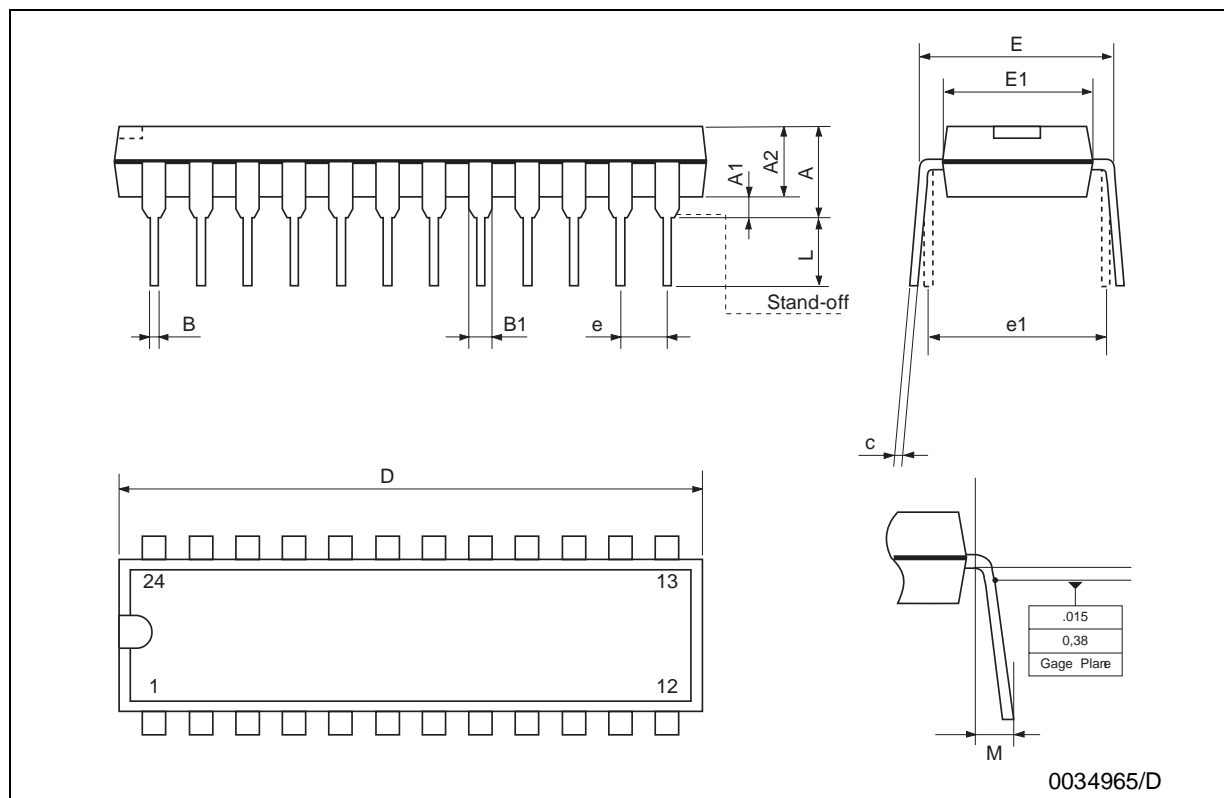
Figure 12: AC Characteristic



**Figure 13: Output Current- $R_{EXT}$  Resistor****Figure 14: Power Dissipation vs Temperature Package**

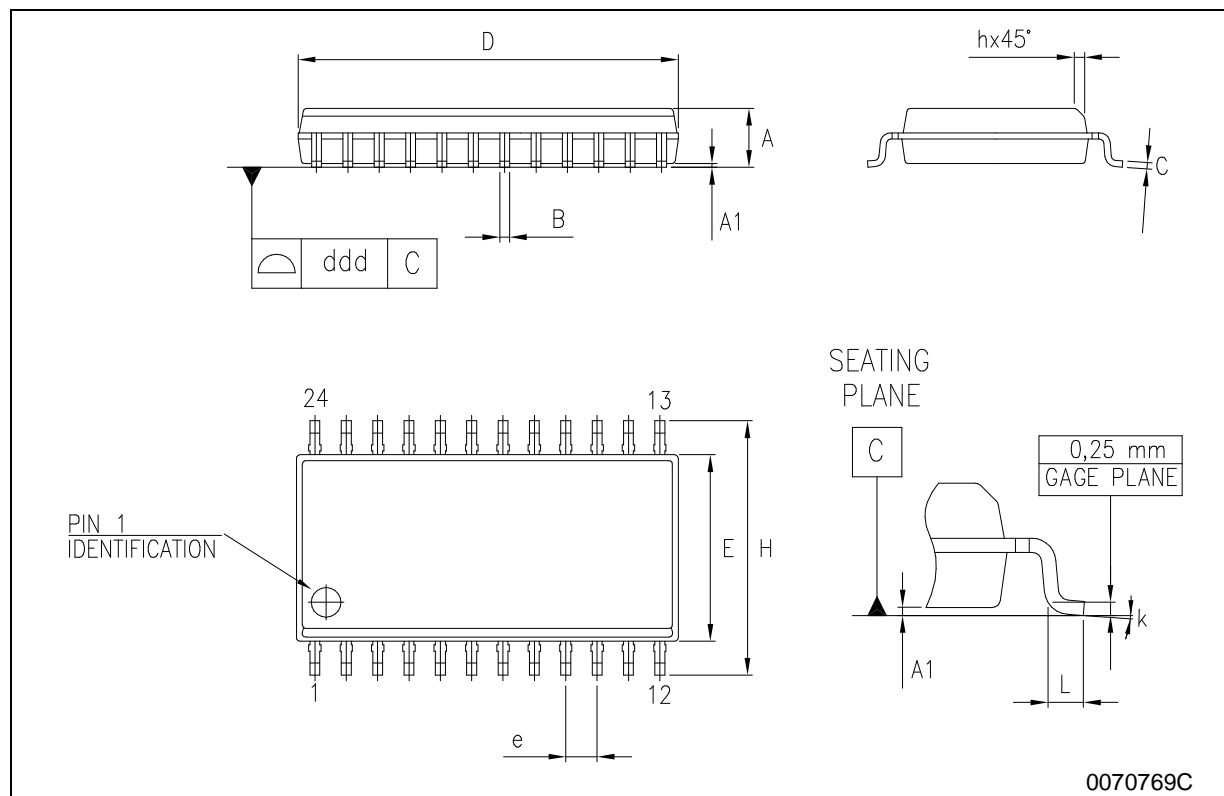
### Plastic DIP-24 (0.25) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.32			0.170
A1	0.38			0.015		
A2		3.3			0.130	
B	0.41	0.46	0.51	0.016	0.018	0.020
B1	1.40	1.52	1.65	0.055	0.060	0.065
c	0.20	0.25	0.30	0.008	0.010	0.012
D	31.62	31.75	31.88	1.245	1.250	1.255
E	7.62		8.26	0.300		0.325
E1	6.35	6.60	6.86	0.250	0.260	0.270
e		2.54			0.100	
E1		7.62			0.300	
L	3.18		3.43	0.125		0.135
M	0°		15°	0°		15°



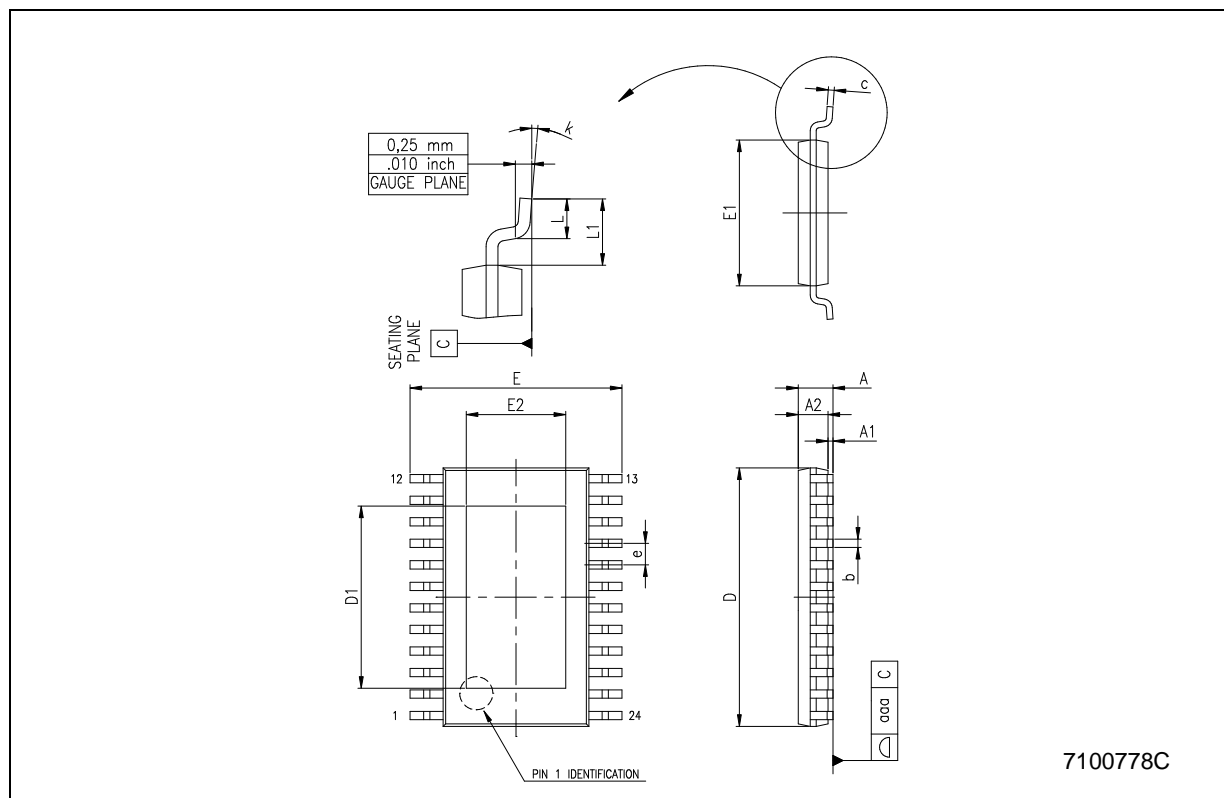
## SO-24 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.30	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	15.20		15.60	0.598		0.614
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10.00		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
k	0°		8°	0°		8°
ddd			0.100			0.004



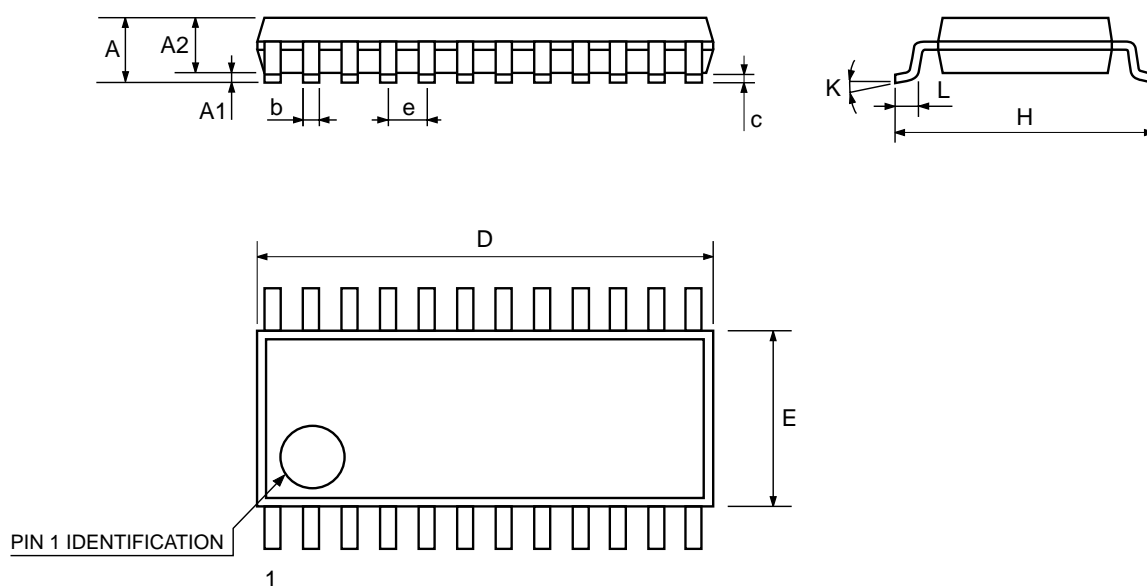
## TSSOP24 EXPOSED PAD MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1			0.15		0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	7.7	7.8	7.9	0.303	0.307	0.311
D1	2.7			0.106		
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.5	0.169	0.173	0.177
E2	1.5			0.059		
e		0.65			0.0256	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



## TSSOP24 MECHANICAL DATA

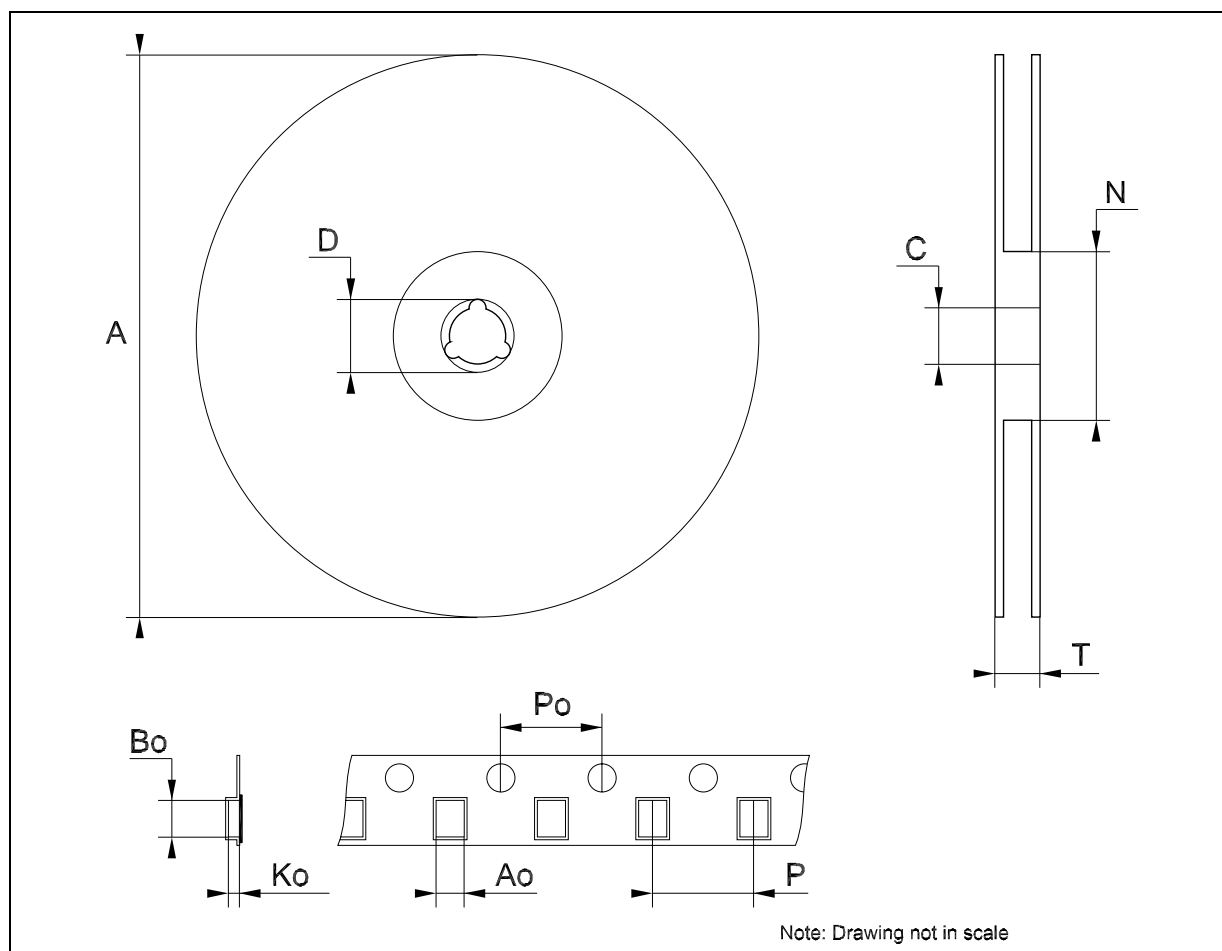
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.1			0.043
A1	0.05		0.15	0.002		0.006
A2		0.9			0.035	
b	0.19		0.30	0.0075		0.0118
c	0.09		0.20	0.0035		0.0079
D	7.7		7.9	0.303		0.311
E	4.3		4.5	0.169		0.177
e		0.65 BSC			0.0256 BSC	
H	6.25		6.5	0.246		0.256
K	0°		8°	0°		8°
L	0.50		0.70	0.020		0.028



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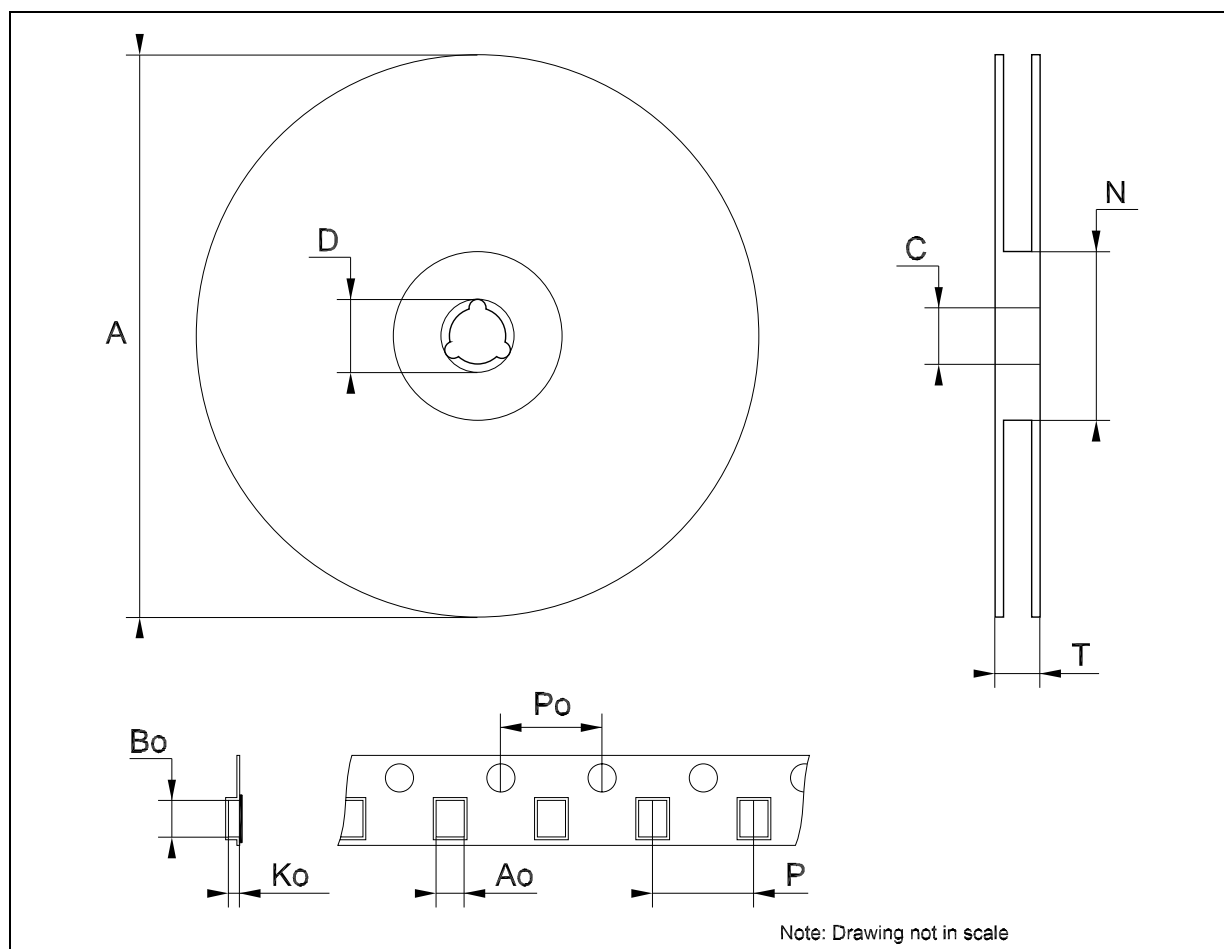
### Tape & Reel SO-24 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			30.4			1.197
Ao	10.8		11.0	0.425		0.433
Bo	15.7		15.9	0.618		0.626
Ko	2.9		3.1	0.114		0.122
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



### Tape & Reel TSSOP24 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.8		7	0.268		0.276
Bo	8.2		8.4	0.323		0.331
Ko	1.7		1.9	0.067		0.075
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476





**Table 10: Revision History**

Date	Revision	Description of Changes
06-May-2004	4	Table 6 and Table 7 parameters changed.
03-Aug-2004	5	Figure 14 - pag. 10 is changed.

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